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MODELLING PLANT-INSECT INTERACTIONS: THEORY AND APPLICATION IN CROP PROTECTION

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ABSTRACT

Reducing the use of chemicals and thus developing environmentally friendlier methods such as biological control is one of the current important challenges in crop protection. But, even if biological control has developed very rapidly in the past decades, its successes in efficiently controlling insect pests have been mixed. Modelling and simulation tools can help to grasp biological interactions and also improve biological control.

At the core of any biological control program lies a tri-trophic food chain linking plants, pests and their natural enemies. However, up to now, biological control modelling has primarily focused on pests-natural enemies interactions considering somehow that crop yield is not affected by the pests. In practice this assumption is not always realistic. If the main objective of the control is to maintain the crop yield above a critical threshold, then plant growth and plant-insect interactions have to be taken into account...Not an easy task!

Using a minimal modelling approach, our contribution focuses on plant-insect interactions as a first step towards a full plants-pests-natural enemies model. Plant growth is modelled in such a way that the growth pattern of the plant and its final biomass are both dependent on the initial pest's infestation level. This contrasts with most population dynamics models, including plant-grazers models, which after some transients tend to produce similar dynamics for different initial conditions.

Numerical simulations are provided using parameters identified in the literature to illustrate the model dynamics on the interaction between tomato plants and a leafminer, *Tuta absoluta*. In particular, the results show that well timed pests control interventions (mechanical control or non-persistent bio-pesticides) have important effects on the growth pattern and the final biomass of the tomato plants.

Key words: continuous dynamical system, numerical simulation, plant growth model, insect population dynamics, control, *Tuta absoluta.*